Dear Editor

We would like to thank the referee for her/his carefully reading of our manuscript LE11524 "First observation of $K_L \rightarrow \pi^{\pm}e^{\mp}\nu e^{+}e^{-}$" and giving suggestions. Below are our response to the suggestions and the changes made to the Letter in response. We have also updated Figure 2 to be clear in black and white.

1. *The description on the next-to-leading order ChPT [NLO(p^4)] is not enough. Since the reference [8] is "in preparation", readers are unable to get information on NLO(p^4) used in the analysis, even though they might get some information from Fig.3. More should be described in the introduction or in the summary, for the readers not in this research field. (For example, does NLO(p^4) introduce new parameters or constants in the theory and can this measurement determine some of them ?)*

   Answer:

   We changed the last sentence of the second paragraph in page 1 adding a brief information for NLO(p^4).

   Before:
   In this letter, we compare our measurements against ChPT calculated to next-to-leading order, expanded to the fourth power of the momentum of chiral field p [NLO(p^4)].

   After :
   In this letter, we compare our measurements against ChPT up to the $\mathcal{O}(p^4)$. The next to leading order [NLO(p^4)] terms include the low-energy constants, the chiral anomaly, and one-loop diagrams [6].

   With this change, the order of references were changed.

2. *In page 4 the authors write:*
   "Missing pions are due to track hits corrupted by hadronic interactions in the detector material, while the analysis magnet causes low momentum tracks to escape the detector".
   I expect, in the analysis there would be criteria on the minimum momentum (or energy) to the electron and pion tracks in the lab frame. Such criteria should be described.

   Answer:

   We added a sentence in the fourth paragraph of page 2, as the following:
   The tracks for pions and $e^{\pm}_{ke3}$ are required to have momentum greater than 10 GeV/c, and the electron candidates are required to have momentum greater than 3 GeV/c.

3. *In Fig.2, "MC total" does not reproduce "Data" so well in the region $k_{+-0} > 0.03$ GeV^2/c^2. That is not a serious problem to the analysis itself, but we would have an explanation to it in the manuscript, if possible.*

   Answer:

   The discrepancy between data and MC total in the region $k_{+-0}>$ 0.03 GeV^2/c^2 was not thoroughly investigated, since it does not affect the accepted data sample. We made sure that is not a problem by carefully confirming the background estimations for data in the accepted region of k_{+-0}. (We attach some figures for this issue at the end of this note.) Therefore, we added a sentence at the end of the figure caption as:

   The disagreement between data and MC in the range $k_{+-0} > 0.02$ GeV^2/c^2 does not affect the background estimate in the signal region. Data-MC comparisons between many other distributions in the accepted k_{+-0} region show good agreement leading us to conclude that the backgrounds are well-modeled in the region of interest.

4. *In page 7:*
"The systematic error is much larger than that of R, due to the 2.7% error on $B(\pi^0 \to e^+e^-\gamma)$*."*
and the error on $B(\pi^0 \to e^+e^-\gamma)$ *is the largest in their measurement.*
I have heard, in some conferences, that KTeV collaboration is going to do a new and better measurement of $B(\pi^0 \to e^+e^-\gamma)$ *with their data. If that is true, for future the error on* $B(\pi^0 \to e^+e^-\gamma)$ *should be taken care of separately in the results.*

Answer:

We separated the systematic error of Eq.3 and Eq.4 in two parts, as the following:

$$\begin{aligned} &B(K_{e3ee}; M_{e^+e^-} > 5\mathrm{MeV}/c^2, E^*_{e^+e^-} > 30\mathrm{MeV}) \\ &= [1.285 \pm 0.010(stat) \pm 0.020(syst) \pm 0.034(syst_{\pi^0 D})] \times 10^{-5}, \end{aligned} \tag{3}$$

where *syst* indicated systematic error without from $B(\pi^0 \to e^+e^-\gamma)$, and $syst_{\pi^0 D}$ indicates systematic error from $B(\pi^0 \to e^+e^-\gamma)$.

$$\begin{aligned} \mathcal{R}_{Ke3ee} &\equiv \frac{\Gamma(K_{e3ee}; M_{e^+e^-} > 5\mathrm{MeV}/c^2)}{\Gamma(K_{e3})} \\ &= [4.57 \pm 0.04(stat) \pm 0.07(syst) \pm 0.12(syst_{\pi^0 D})] \times 10^{-5}. \end{aligned} \tag{4}$$

Sincerely

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We attach some figures to confirm background estimations on the next page.

Here we show three plots to confirm background estimations:

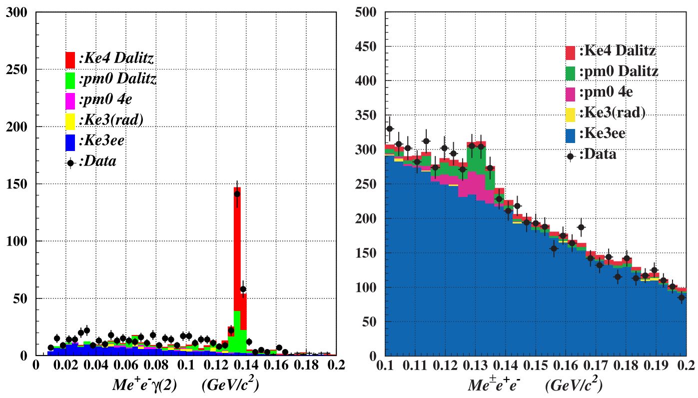

Figure 101: Left: Distribution of the invariant mass of $e^+e^-\gamma$ system for the events detected with one photon. Background MC plots were not overlaid but accumulated. This figure shows that the background from $K_L \to \pi^{\pm}e^{\mp}\nu\pi^0_D$ is estimated properly. Right: The $M_{e^{\pm}e^{+}e^{-}}$-distributions of data and MC s arround 0.13 GeV/c^2 after all cuts. Background MC plots were not overlaid but accumulated. We confirmed that $K_L \to \pi^+\pi^-\pi^0_D$ and $K_L \to \pi^+\pi^-\pi^0_{4e}$ made a peak at 0.13 GeV/c^2 on the $M_{e^{\pm}e^{+}e^{-}}$-distribution. Data and MC well agree.

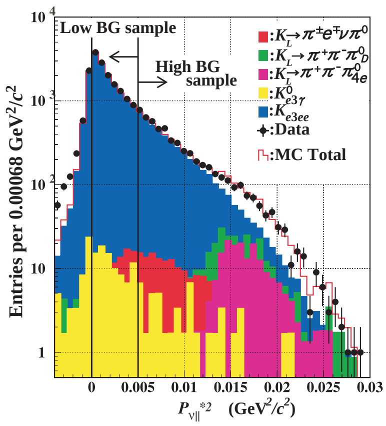

Figure 102: Distribution of the square of the longitudinal momentum of neutrino in the kaon rest frame $P^{*2}_{\nu||}$. Background MC plots were overlaid. The low background sub-sample and the high background sub-sample are separated by a vertical line on $P^{*2}_{\nu||}$= 0.005 GeV^2/c^2. To confirm our background estimation, we compared $\mathcal{R}(ke3ee/+-0_D)$ between the signal regions $0 < P^{*2}_{\nu||} < 0.005$ GeV$^2/c^2$ and $P^{*2}_{\nu||} > 0.005$ GeV$^2/c^2$, in which the total background is 1.7% and 13.7% of the number of signal candidates, respectively. There was no significant difference in $\mathcal{R}(ke3ee/+-0_D)$ between samples in two $P^{*2}_{\nu||}$ regions (1.6 σ). This fact assures the quality of the background estimations.